THE SIDEREAL MESSENGER,

CONDUCTED BY WM. W. PAYNE,

DIRECTOR OF CARLETON COLLEGE OBSERVATORY, NORTHFIELD, MINN.

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OBSERVATIONS AT CLOVERDALE, CALIFORNIA.

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FOR THE MESSENGER.

It was three months ago that I first suggested to leading members of the Pacific Coast Amateur Photographic Association that good work could be done by the members at the total eclipse on the first day of the present year, and it was exceedingly gratifying to me to observe the disinterested enthusiasm with which the proposition was entertained. By the word "amateur" I do not mean home-made apparatus and mere dabblers in the art of photography, for the Association has within its ranks men who probably have no superiors in the photographic art, and their outfits are as elaborate as wealth can buy.

Out of this association, composed as it is of men engaged in active business pursuits, many of whom could ill afford either the time or expense required, thirty cameras were pointed at the sun at our station (Cloverdale, Sonorra County, California), on the morning of the eclipse. Among this formidable battery were a few amateurs and two professionals who were not members of the Association, but all who were willing to devote their results to science were welcome to take advantage of our arrangements.

The Association had made me an honorary member and placed me in full charge of the expedition. On December 29th, accompanied by Messrs Harry T. Compton, Marston Campbell, Alpheus Bull, Jr., and C. P. Grimwood, I arrived at Cloverdale and at once selected our station and we began observations for latitude and longitude. Our station was in the midst of the little village, on a block of land kindly given us by Mr. M. Minnehan. It was surrounded by a neat fence, the only other improvement being a small cottage, a room of which was kindly given us by the owner in

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which we could keep our instruments, thus saving much labor in carrying them to and from the hotel.

Mr. Compton, assisted by Mr. Campbell, established the latitude of our station by a large number of observations with a sextant and artificial horizon, while I observed for time, with a small astronomical transit kindly loaned me by Mr. Edward Dillon, of Dillon & Co., San Francisco. I am desirous of thanking this gentleman also for the use of a mean time chronometer and, while under this head, I wish to thank the management of the San Francisco & North Pacific Railroad Co., for free and careful transportation of our instruments; the Western Union Telegraph Co., and Mr. Jones and Mr. Vandenberg for sending us the clock signals of the Lick Observatory for three days preceding the eclipse.

As the mean of Mr. Compton's sextant observations on the sun and Polaris and my own time observations and chronometer comparisons with the Lick clock, we found our position to be:

$$\text{Latitude} = 38^\circ\ 47'\ 40''\ \text{N.}$$
$$\text{Longitude} = 122^\circ\ 57'\ 25''\ \text{W.}$$

On the evenings of the 29th and 30th of December the sky was perfectly clear; but on the night of the 31st, when the members of the Association joined me, clouds had gathered, and there were evident signs of rain. However this did not dampen the ardor of the gentlemen, and we all assembled in the dining room of the hotel, where I was put through a sort of astronomical catechism by eager searchers after detail. We finally went through several drills in the matter of counting, etc., so that they would all have a complete understanding of what they were to do. It was agreed to meet at nine o'clock next morning at the station selected, and there drill again when all the cameras and other instruments were in position.

On the morning of the 1st, though the sun rose clear, there were banks of cloud on the horizon, and overhead masses had gathered which were slowly moving away. As the sun gathered strength the clouds became more fleecy and began to dissipate, the improvement in the weather continuing as the day advanced.

Carpenters had previously made trestles and inclined boards to be used instead of tripods for most of the cam-

eras. The thirty cameras were then set up in two long rows, a place in the center being reserved for the telescopes, chronometer, etc. By 10 A. M. all the instruments were in position and drilling commenced. The drilling, which was done a number of times, corresponded to the programme afterwards carried out in the matter of counting and recording time. The system was as follows:

In order that there should be uniformity with regard to time, and each should know exactly the period at which the different plates were exposed and the time of exposure, a battery and telegraphic sounder were connected with a break-circuit sidereal chronometer so that the beats of the seconds were sounded. About one minute before totality, Mr. Alpheus Bull, Jr., began counting aloud, so all could hear distinctly, he taking the time from the sounder. This preliminary counting was done to determine how long before totality any observer could notice the corona, and each one noted on a prepared card when he saw it.

Meanwhile Mr. Compton with a sextant and Mr. Wm. M. Pierson with a 3½-inch refractor observed for time of second contact. As totality commenced Mr. Compton and Mr. Pierson simultaneously called "time" and immediately Mr. George H. Strong commenced counting aloud, taking the sounder as his guide. The work of the photographers then began and continued until the last instant of totality was called, when Mr. Strong ceased counting, and Mr. Bull again commenced counting till he had counted fifty-five.

The counting after totality was so that the length of time the corona could be noticed might be recorded. The object of having two men to call was that voices of different tones could be recognized as marking the periods before and after totality and during total phase. Each photographer had an assistant and each assistant had a card devised by W. H. Lowden, on which was printed a row of figures from 1 up to 200. His instructions were to indicate on this card the exact second of totality, at which the lens of the camera was uncapped and again when replaced, and repeat this as many times as there were plates exposed. This card then furnished a record not only of the time of exposure of each plate, but the period during totality the exposure was made. The assistant had but to listen to the voice of Mr.

Strong, who was calling, and mark on the card the number being called, as the lens was uncapped and capped. This arrangement proved perfect, as in every case the time and period of exposure of every plate is known, and all were working on the same time by chronometer.

The first and fourth contacts were not observed for, as we only cared to know when to begin our photographic work, and to know just the exact second of the time of totality each plate was exposed. The following times are probably right within half a second:

Second contact = $1h\ 46m\ 43.50s$,
Third contact = $1h\ 48m\ 27.50s$,

the duration being only $1m\ 44s$ by sidereal chronometer.

The predicted times at Cloverdale, in the pamphlet issued by the director of the Lick Observatory (and which were believed to be only approximate), were:

Time of second contact = $1h\ 46m\ 44s$ P. S. T.
Time of third contact = $1h\ 48m\ 32s$ "
Duration of totality = $1m\ 48s$ "

The time of contacts played but a small part in our work, as those who observed and recorded them had little or no experience in exact observations.

A card with a central black disk to represent the moon had been prepared for each one, and upon this each was to draw the corona as it appeared to him, and then turn it over to the President of the Association without correction or comparison with other drawings. These drawings have all been handed in and, with the original negatives and all of our work, will be sent to the Lick Observatory.

When Mr. Bull counted forty-two (ten seconds before totality), several members saw the corona very distinctly. Two members, Mr. W. C. Gibbs and Mr. George A. Story, claim to have seen it forty-three seconds before totality. After totality the corona was carefully watched and was lost generally from forty to fifty-five seconds after, with the exception of Messrs. A. J. Treat and George H. Strong, who state that they followed it sixty-nine and seventy seconds respectively.

The ladies of the party were skillful colorists and were instructed to protect their eyes preceding the total phase, so that the eyes would be color-sensitive. They describe the

color of the sky before totality as being a leaden blue. It became brighter and more luminous during totality as it extended up to the corona. The light near the disk of the moon was an intense luminous silver, with a bluish tinge similar to the light of an electric arc. The outer corona was similar in color, though fainter, fading away into the surrounding sky. The disk of the moon appeared of a gaseous aspect and of a dark, hazy, purple color. At no time did it appear black. The streamers, which extended in an oblique direction, were of the same color as the outer corona. Warm colored or red rays were not observed by those who had made their eyes sensitive by protection previous to totality.

One of the best drawings was that made by C. Mason Kinne of the San Francisco Microscopical Society. He used a low objective and saw the color of the inner corona as a cold, steely blue, fading into purple red and slight yellow. He also observed a slight protuberance on the northwest periphery.

Captain C. L. Hooper, of the United States revenue cutter Corwin, had a 2½-inch telescope, but noticed no color at all in the corona. It was a swallow-tail shape and expanded about one degree on each side, as nearly as he could judge, in the direction of the ecliptic. No signs of protuberances or flames were noticed. The light appeared like that from a shaded electric light.

I was disappointed at the almost utter absence of sun-flames, a few very small ones appearing in the best photographs.

There were about seventy-five members of the party. Thirty of these were photographers and thirty recorders the rest performing other duties with the telescopes, sextant, meteorological instruments, etc. There were in all one hundred and sixty-seven negatives made. The shortest exposure was one-fiftieth of a second on a quick plate; the longest was forty-one seconds on a slow plate, the rest varying between these extremes. The photographing was systematically done. To each photographer were allotted certain times of exposure for his plates, taking into consideration such elements as character of lens and plate, length of focus, etc.

The results with the camera vary mainly in degree of extent of corona and size of image. Owing to the variety of quickness of the plates, difference of length of exposure and methods of development of negatives, a number of facts have been established which will serve as a valuable guide to future work of this character. Nearly all of the negatives made have been developed.

It is found as a result of the work accomplished thus far that there was no necessity for very long exposures of the plates, the light of the corona being better from a photographic point of view than was, perhaps, expected. The best general results have been obtained with an exposure of three seconds on a quick plate with an aperture not less than one-tenth the focal length of the lens. The negative made on a slow plate in forty-one seconds shows Mercury plainly, but so also does another which was only exposed ten seconds, and perhaps close inspection will reveal this planet on other negatives, though nothing under ten seems to show it.

The inner corona was satisfactorily photographed in one second, and exposures of only a twentieth of a second show it also very well. The outer portion required a longer time. Probably the five-second exposures on a rapid plate give about as great an extent as it is possible to photograph. The greatest extent was that shown in the forty-one second negative, where it is pictured as extending on two sides, about two diameters of the moon; but probably fifteen or twenty seconds exposure would have answered as well. The forty-one-second plate would seem to prove that the visual light of the extreme outer corona is greater than its photographic strength for the reason that in this case the rays merge into the diffused light of the sky at a less distance from the moon than the drawings made by observers appear to indicate. In developing this negative the sky was also developed, showing that it was impossible to obtain on a photographic plate any greater extent of corona than is shown thereon.

The photographers of our party think that hereafter exposures should be made separately for different parts of the corona. Short exposures, say of not over one second, should be given to obtain details of the inner corona; others

of two or three seconds for details of the outlying portions; and others of five seconds and over to obtain the extreme limits of light given by it. These plates should, of course, be developed understandingly to get the best results from each. In the second and third class of exposures the inner corona would have to be entirely sacrificed in the development of the negative, while in the first, care should be taken to preserve all the detail possible.

It would seem from the results that the actinic strength of the light of the inner corona has been underrated, as the exposure of one-fiftieth of a second on it gave a good image. The light as shown on the negatives, especially the larger ones, is represented as long fine rays or wisps extending apparently from the edge of the moon's disk. Professor Langley thought at a previous eclipse that these wisps or rays were themselves formed of bunches of rays or wisps, and has been anxious for proof of his theory. The negatives made show that he was right; the broom-like rays are themselves formed of small bunches of rays like the separate bunches in a broom which go to form the whole. These show clearly on the negatives, but not so plainly on the prints.

Dr. Passavant took with him a Warnercke sensitometer for the purpose of testing the actinic strength of the light of the corona. He reports that an exposure was made by his assistant, Thomas Andrews, on an „H. L." plate, which registers 15 on the sensitometer by the ordinary tests. This exposure lasted fifteen seconds, commencing at forty-one seconds after totality and ending at fifty-six.

This photographic plate, of known value, was cut into four pieces. At the time of the next full moon another piece of this same plate will be exposed in the same sensitometer to the moonlight for a like period. Proper meteorological observations will be made and recorded at the same time. Still another portion of the plate will be exposed under the sensitometer to the standard light used by all photographic plate-makers. These plates will all be developed at the same time and with the same chemicals. They are expected to show: First, the standard value of the plate; second, the exact relation of the photographic strength of the diffused light of the corona as compared with that of the full moon.

This will enable photographers in the future to determine more accurately the proper exposure to be given the corona, even though the advances in photography should place the plates of to-day, so far as rapidity is concerned, very much behind the plates of the future.

The results of the above experiment will be forwarded in time for the next MESSENGER.

The party consisted of the following:

Members of the Photographic Association—A. J. Treat, S. C. Passavant, O. V. Lange, Charles G. Yale, P. Carleton, C. F. Montealegre, J. W. Stanford, J. V. A. Rey, Eugene Frost, Samuel C. Partridge, W. C. Gibbs, George W. Dornin, William Letts Oliver, J. H. Johnson, E. W. Runyon, A. P. Redington, W. H. Chapman, W. H. Lowden, E. L. Woods, George Tasheira, F. H. McConnell, George W. Reed, C. L. Goddard, W. S. Davis.

Assistants—Alpheus Bull, Jr., Harry T. Compton, Marston Campbell, C. P. Grinwood, George H. Strong, William F. Booth, W. B. Ewer, Lew Tasheira.

Recorders—H. W. Schwerin, William N. McCarthy, W. C. Edes, Alfred K. Gibbs, M. P. Donnelly, F. C. de Long, George A. Story, J. A. Bauer, E. S. Gray, E. B. Moore, George B. Baer, Walter Henry, M. Seligson, E. P. Livingston, F. S. Wright, C. W. Wilkinson, Harry Phelan, Moses Callan, Thomas Andrews, Mrs. C. L. Goddard, Miss Hermione Rey, Mrs. E. S. Gray, Mrs. George Tasheira.

Sketchers—Mrs. George Roe, Miss Silvia Rey, Miss Truesdell, Miss Treat, Col. C. Mason Kinne, Capt. W. B. Hooper.

The following professional and amateur photographers not connected with the Association were also present: I. W. Taber, A. C. Burnham, W. B. Tyler, Louis de F. Bartlett, Bert Remmel.

It may be here mentioned, as all were working under directions and allotments as to time of exposure of plates, some had to be "sacrificed" so as to get variety in results. For instance, Mr. Lowden to whom was assigned the forty-one-second plate expected to get nothing from so long an exposure.

My own instrument was the largest one in our party, my telescope is a 10½-inch Newtonian reflector, made by Brashear, and this I converted for the time being into a

telescopic camera. It was mounted in a wooden tube 12 inches square and 8 feet 6 inches long. A special diagonal whose minor axis was 3¼ inches was specially made so that the field would be large enough to include the sun and any

From a photograph by Mr. Burkchalter; exposure 2 seconds.

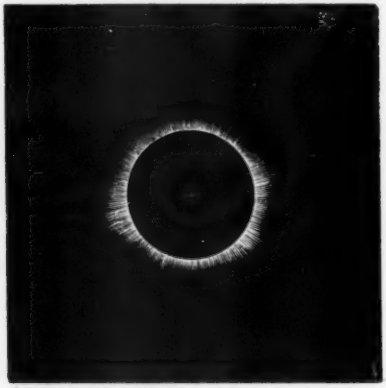
possible extent of its corona. Two slow-motion attachments were provided to follow the sun in altitude and azimuth. This was all mounted on a working platform, so

From a photograph by Mr. Burckhalter; exposure 3 seconds on slow plate.

it could be pointed at the corona at the proper moment without loss of time. Mr. Charles G. Yale had charge of this mechanism. The tube was carefully blacked inside and

everything done to prevent fogging the plate, but this was known to be an impossibility in an open tube. It was only a question whether the plate would be fogged beyond all value or not.

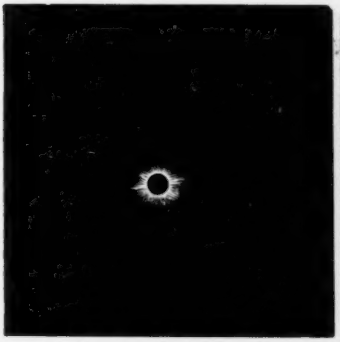
The manner of exposing the plate was by cutting an opening in the top side of the tube and adjusting the back portion of the camera that holds the plate holder over this opening. A small telescope with a large field was placed on the tube as a finder. The image was thrown to one side of the center just before totality, and no attempt made to follow the moon during the time of totality.



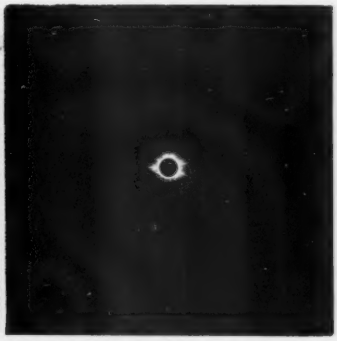
From a photograph by Mr. Burckhalter; exposure 1 second on slow plate.

The focal length of this camera was 84 inches, the longest in the field. The diameter of the image is thirteen-sixteenths of an inch, the largest made by any except that of the 13-inch instrument of the Harvard Observatory party. In this camera ten plates were exposed, varying from half a second to ten seconds. The plates used were Passavant, "C. I. P.' and "H. L.," with a sensitometer register of 22 and 15 respectively. Wm. F. Booth recorded, and Marston Campbell uncapped and capped the lens, I exposing the plates myself.

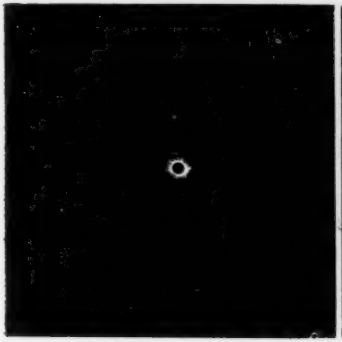
W. H. Lowden made special preparations with a view to obtain a long exposure on the corona. For this purpose he used an 11 x 14 camera mounted in such manner that during exposure he could follow the moon and keep it in the cen-



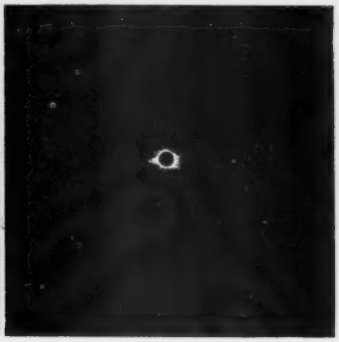
From a photograph by Geo. W. Dornin; exposure 10 sec.; from 53d to to 63d sec. of totality; focus, 17-inch; plates, Seed 25s.



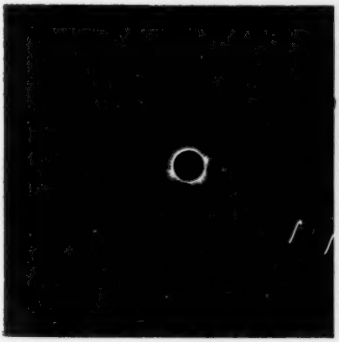
From a photograph by A. J. Treat; exposure 6 sec.; Passavant plate 15 sensitometer; Darlot No. 3 lens, 12 inches back focus.



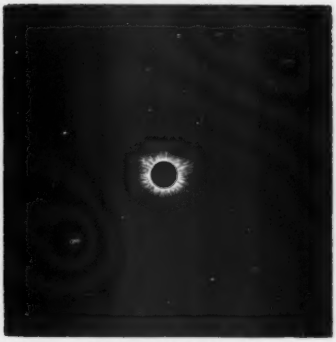
From a photograph by V. J. Rey, Miss H. Rey, assistant; lens, double combination No. 1; euryscope; focus 8½ inches; plate, Seed 26; exposure between 47th and 49th seconds of totality.



From a photograph by E. W. Runyon assisted by A. P. Redington; Steinheil antiplanatic double lens; stop, largest size; focal length, 10⅞ in.; H. L. plate, Passavant special; exposure 4 sec., 65th to 68th.



From a photograph by W. C. Gibbs; Lancaster single-view lens, 22-inch focus; exposure 1 sec. from 31st to 32d; C. I. P. plate, sensitometer 22.



From a photograph by C. F. Montealegre; exposure, 3 sec., 18th to 21st; Morrison sencoscope, 3 in. aperture; Eastman's American film plate transferred to and left on theglass, (hence the reversal of the poles).

ter of the plate. A Beck lens of twenty-two-inch focus with a three-inch aperture was used, and on top of the camera he mounted a two-inch telescope. Two exposures were obtained, one of forty-one seconds and one of twenty-eight, the latter embracing the last second of totality. These were made on extremely slow plates prepared by Dr. Passavant, which, being very rich in silver, were expected to show the detail of the extreme outer corona. The plates have been developed and are regarded as very successful. The corona is shown to a distance of nearly two diameters on each side of the moon, while the movement of the image is not perceptible, showing that the apparatus was well adapted to the difficult experiment, and carefully handled. Mercury is distinctly shown on both plates. Mr. Lowden made the mounting for this box himself, and it worked in a very satisfactory manner.

Mr. Yale took up with him a set of meteorological instruments furnished by Melville Attwood, John Roach and the Chabot Observatory. Mr. W. B. Ewer kept the records. The wind was so light that the anemometer scarcely recorded it. The black-bulb thermometer exposed to the sun recorded 69½ at 12:35, 62 at 1 P. M., 61 at 1:15, 52 at 1:35, 46 at 1:45 and 42 during totality. The dry-bulb thermometer registered 55¼ at 12:35, 54 at 12:50, 55½ at 1:07, 54 at 1:25, 57 at 1:40 and 51 during the total phase. The wet-bulb thermometer ran down from 51½ to 49, the latter figure during totality. The barometer dropped 5-100 during the total phase, quickly returning to normal, 39.093, on its conclusion.

I feel that I cannot close this already long article without mentioning our very narrow escape from our total failure. A light cloud covered the face of the moon and was photographed by Mr. Oliver only one and one-half minutes before second contact, and drifted off only thirty seconds before, and another light cloud again covered the moon only two minutes after the end of totality. I wish also to record the fact that the general light—visually speaking—was fully four if not five times brighter than bright moonlight and our lanterns were not needed.

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AUTOBIOGRAPHY OF ALVAN CLARK.*

Some years ago, when residing in Cambridge, I became acquainted with the late Mr. Alvan Clark, the distinguished astronomical instrument maker, and after coming to Washington I had some correspondence with him. Among his letters is one containing his autobiography, written at my request ten years ago last October. If you think it would be of interest to the readers of the *Register* you may publish it there:

Cambridgeport, Oct.....1878.

My Dear Sir:

The account of my career you have desired I can write in pencil more conveniently than with ink. I have written but little in my life, and less of late than ever; so it is hard and slow work for me.

My father's name was Abram, and he was born in Harwich, Mass.; and my mother was Mary Bassett, born in Dennis, Mass. They removed to Ashfield, Franklin County, Mass., in 1794, where I was born, March 8, 1804. I was the fifth son of ten children, seven sons and three daughters; five of us are living at this date.

Our farm of 100 acres was one of the roughest and most rocky in that rough and rock town, and over the greater part of it, when I was a lad, the stumps of the primitive forest trees, mostly hemlock, and some very large, were standing. Two splendid trout brooks joined near the lower or eastern border of the farm, upon the larger of which is a grand waterfall near the middleof the farm, but being three and a half miles from the center of Ashfield, and about the same distance from Conway and Goshen centres, it has attracted little attention. The year I was born my father built a sawmill just below the confluence of these streams, and close upon the line between Conway and Ashfield. It was a fourth of a mile from the house in plain sight and of course a prominent object in my childish thoughts. It was washed away after standing seven years, but rebuilt when I was eight. I concluded then I should be a mill-wright, being

* Communicated to the *New England Historical and Genealogical Register* by Hon. William L. Richardson, LL. D., Chief Justice of the Court of Claims, Washington, D. C.

wonder-struck by the achievements of Capt. Gates, the chief in this work of rebuilding.

The first school-house in the district was located on our farm, and built when I was seven years old. At times forty scholars have attended there where now they can scarcely muster ten, and I sometimes might be inclined to fear that in forsaking a home abounding in inviting influences, my example had been pernicious, were it not that I see with regret the same depopulation going on almost all over the rural portions of New England.

An old grist mill located by the waterfall, built before I was born, was purchased by my father when I was about twelve. The school, the farm and these mills busied me until about seventeen, when I began to think that perhaps I might be better fitted for some other calling, and I went into a wagon-maker's shop and worked about a year with an older brother, but returned to the paternal mansion and put myself at work in good earnest to learn alone engraving and drawing, though I had first visited Hartford, and seen something of such works which were cheerfully explained to me, green as I was, by strangers well skilled, of which there were a number at that time in the place. I visited Boston in the autumn of 1824, carrying with me specimens to show my proficiency, which though not great, was sufficient to secure me a living employment for the time.

Supplying myself with some of the most needed art materials I returned to Ashfield the next May, and spent the summer as studiously as possible, with no settled plans further than the acquisition of skill. In neighboring towns I offered my services in making small portraits, some in India ink and some in water colors, and with a pretty satisfactory measure of success.

Here I must give you one little incident which tends to show what small matters can change the course of a human life. Wanting some fine sable hair brushes, I sent for them by a man in the habit of visiting Boston. Upon looking over a piece of newspaper in which they were wrapped when received, my eye fell upon an advertisement of recent date, headed, "Engravers Wanted." I was not long in making up my mind to apply for the situation. On reaching Boston I found the engravers were wanted at the engraving shop of

the Merrimac Works in East Chelmsford for calico printing. The agent informed me that they had just contracted with Messrs. Mason and Baldwin of Philadelphia to do their engraving, and that one of the firm would soon be in East Chelmsford and very likely would employ me as an assistant.

Mason at once on his arrival offered me eight dollars per week for one year and nine dollars per week for three succeeding years, with opportunity for learning the art in which they were engaged. I was to work nine hours in winter and ten in summer per day, which terms I accepted. Such pay would now be considered small for a beginner in housekeeping, but I was able to supplement it a little by painting and cutting stamps out of the shop.

I have always felt that I incurred a very serious risk in marrying as I did. My wife, Maria, was the daughter of Asher Pease, and was born in Enfield, Conn., Nov. 30, 1808. The family removed to Conway and settled on a farm within half a mile of my own father's residence in 1811, where she resided with her parents until our marriage, except for a short time she boarded in the family of Dr. Edward Hitchcock, while he was settled preacher in Conway, previous to his taking the Presidency of Amherst College,—this for the purpose of attending a select school. After remaining about six months in E. Chelmsford, I invited my father to accompany this young woman to the place, which he did, and we were married, as the record shows, on the 25th of March, 1826.* My employer, Mr. Mason, was very kind, and procured credit for me, that we could arrange for housekeeping in an unpretentious way, where I felt that we were established for three years and six months at least.

But a disagreement sprang up between Mason & Baldwin and their employees, resulting in Mr. Masons' returning to Philadelphia; but previous to leaving he offered to cancel our engagement, or take me with him to Philadelphia to serve it out, or he would open a branch shop in Providence R. I., and give me charge of it, with pay of $10 per week and one-fourth the profits. I accepted the last proposition,

* This was the first marriage in the *town of Lowell.* That part of Chelmsford called East Chelmsford was incorporated as Lowell, March 1, 1826. The first town meeting was held at Colburn's Tavern, March 25, 1826, and Mr. Clark was married on that very day, by the late Rev. Theodore Edson.—W. A. R.

as there was no chance that I could remain in the Lowell shop with comfort, for they had imported English engravers who had no notion of allowing the secrets of their art to slip into the hands of Americans. Our tarry in Providence was of only about one year's duration, when this branch of Mason & Baldwin's Works was removed to New York, where I continued on the same terms with them, until the spring of 1832, at which date I received an offer from Andrew Robeson for my services at his print-works in Fall River, such that I was induced to relinquish my connection with Mason & Baldwin. We had but just settled in Fall River when the cholera broke out in New York. Before passing I would say, the partner of Mason was M. W. Baldwin, afterwards the famous builder of locomotives. While residing in New York I had excellent opportunities for studying painting, and practiced all I could, and never gave it up even after removing to Fall River.

In 1835, Lucius Mantrus Sargent was invited by temperance people to give a lecture in each of the churches in the place, and as he was to be several days there, I sought a seasonable opportunity for inviting him to give me sittings for an ivory miniature. During these sittings I questioned him as to my chance of success as a miniature painter in Boston. He asked what practice, or experience, or opportunities for instruction I had thus far enjoyed in the art? After receiving my replies and preceiving that my heart was in it, without committing himself by advice he wished to know the highest price I had ever received for a picture, and when I stated $20 he said he wished to take this home with him and also to pay me $40 for it. This was an expression of liberality to which I had been quite unused, and caused me to throw up engraving and quit Fall River for Boston. The sympathy and friendship thus opened I was permitted to enjoy through the remainder of Mr. Sargent's life, which was of great advantage to me. I bought the house in Prospect Street, Cambridgeport, in 1836, where I resided until 1860; supporting my family by painting portraits and miniatures in Boston.

In 1844 my son George Bassett Clark, born in Lowell Feb. 14, 1827, had been for a time in the academy at Andover as a student, with the view of qualifying for a civil engineer.

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In the course of his scientific reading this youth happened to fall in with some account of casting and grinding reflectors for telescopes, and before mentioning it to me had procured his metal and made a casting for a small mirror. I watched his progress in grinding and polishing with much interest, and perceiving a growing interest on his part I was at some pains to acquaint myself with what had been done, and how done, in this curious art, that my son could have the benefit of my maturer judgment in giving effect to his experiments. We spent much time on reflectors, and found for ourselves that the difficulties which have led to such an extensive abandonment of this form of telescope were really irremediable. The sacrifice here was pretty serious for us with then very limited means. I finally proposed to the youth to try a refractor, but he did not believe we could succeed with it, for the books described it as a very difficult thing.

About this time the great telescope at Harvard College Observatory was put to use, and greatly did I wish to see it and look through it, but Professor Bond informed me that I must come with an order from President Everett before this could be allowed. This order was speedily obtained. I was far enough advanced in knowledge of such matters to perceive and locate the errors of figure in their 15-inch glass at first sight, yet those errors were very small, just enough to leave me in full possession of all the hope and courage needed to give me a start, especially when informed that this object glass alone cost twelve thousand dollars.

I began by reworking some old and poor object glasses of small instruments, there being no material in our market of suitable quality, and after gaining confidence and tact, sufficient, as I thought, to warrant the outlay, I imported one pair of disks of 5¼ inches, and found others in New York of larger size even up to eight inches, of very good quality.

We made some instruments to order and sold some, worked on our own account; but the encouragement was small, until I reported my doings to Rev. W. R. Dawes, the famous double-star observer in England, in 1851. I gave him the places of two new double stars I had discovered the next year with a glass 4¾ inches diameter. One of the stars was in Sextans.

In 1853 I had finished a glass of 7½ inches aperture, with which the companion of 95 Ceti was discovered. Upon reporting this to Mr. Dawes, he expressed a wish to possess the glass, but to test its qualities further sent me a list of Struve's difficult double stars, wishing me to examine them, which I did and furnished him such a description of them as satisfied him that they were well seen. I sold him this glass, and afterward four others, one of which, an eight inch in the hands of Huggins has become well known. Knott, an English astronomer, has one of them 7¼ inches, which he greatly prizes.

Previous to 1859 my correspondence with Dawes had become more extensive than with any other fellow mortal in all my life. I visited him that season, carrying with me one equatorial mounting, and two object glasses, one of 8, the other 8¼ inches. All were admitted without duty at Liverpool, though I paid 30% on the rough glass in Boston; nor was that all, the glass was warranted first quality, and when I informed the deputy collector that a large portion of the amount in invoice was in consideration of the warranty and asked him if any allowance would be made in case it turned out worthless, he said, "No, not a cent, if you buy the devil you may sell him again." The crown *did* turn out defective, and I had to import another and pay 30% again. But we were then under a Democratic administration.

I spent between five and six weeks with Mr. Dawes, visited London with him, and we attended together the visitation at Greenwich Observatory and a meeting of the Royal Astronomical Society, seeing and conversing with many notable personages, among them Sir John Herschel and Lord Rosse. Before taking leave of Dawes, I told him he had paid me more money than I had ever received from one individual in all my dealings with my fellow-men, and it was most gratifying to me that he cordially allowed that I deserved it.

The reports concerning the performance of these glasses, published by Mr. Dawes from time to time, in the Monthly Notices of the Royal Astronomical Society, was of great service to me in procuring orders, without which, situated as I was, the proficiency which comes from long practice could never have been reached. In 1860 Dr. F. A. P. Bar-

nard, now President of Columbia College, New York, then Chief of the University of Mississippi, ordered from us a telescope to be larger than any refractor ever before put to use. I say we, for my two sons G. B. and Alvan G. Clark were well skilled men, on whom my efforts in training had not been thrown away, and who were now ready to embark in an undertaking, the importance of which they were qualified to appreciate.

It now became necessary for us to secure more commodious quarters than had served our purposes thus far, and after visiting various sites, we finally settled where we now are purchasing nearly an acre and one half of land, and erecting our buildings in the summer of 1860. The glass for the Mississippi telescope in the rough was received from the makers, Messrs. Chance Bros. & Co., of Birmingham, England about the beginning of 1862, and within one year from that time Alvan G. Clark discovered with it the companion of Sirius, which after a few days in a fine night Professor George P. Bond was able to see and measure with the 15-inch telescope at Cambridge Observatory. Our glass was 18½ inches, and for the production of such a lens, coupled with this discovery, the Imperial Academy of Paris awarded my son the Lalande prize for 1862.

The war coming on and cutting off all communication with Mississippi, this telescope was sold to parties in Chicago, and is now in charge of S. W. Burnham, who has gained great celebrity by double star discoveries; though much of his work has been done with a glass of only six inches aperture.

We have made many instruments of smaller size, but one of 12¼ inches for the Pritchett School Institute of Glasgow, Missouri; one of 12¼ inches for Dr. Henry Draper, of New York, one of 11⅞ inches for the Austrian Observatory at Vienna, and one of 11 inches for the Observatory at Lisbon, Portugal. Also one of 12 inches for the Wesleyan University of Middleton, Conn., and have now in hand one of 15½ inches for the University of Wisconsin, at Madison.

But the most important work we have ever attempted was making two telescopes of 26 inches clear aperture, one for our government, and one for L. J. McCormick, of Chicago. The orders for them were received in the summer of

1871. The government telescope was delivered in the autumn of 1872, and it was with this instrument that Professor Asaph Hall discovered the two satellites of Mars at the time of its last opposition. The government paid us for this work $46,000. The McCormick telescope is not yet entirely finished, but will be very quickly when provisions are made for it, in the way of a suitable site and buildings, and the support of a competent astronomer.

Now I must give a narrative in response to another query.

Dr. Jacob Bigelow returned from a visit to Europe soon after the great telescope at Cambridge was placed in the Observatory. Knowing that he had been in Munich where it was made, I asked him one day in the street if he saw the establishment where it was made? He answered in the negative. When I informed him that I was interested in such matters and was then at work upon object glasses, he remarked, that if I wished to learn to make telescopes I must go where they make them, and passed along. Some years later the Rumford Committee sought information as to what original means or methods I employed. My reply was that I knew so little of the doings of others that I could not say, but if they would meet at our shop, I would explain to them as well as I could the steps by which I had been in the habit of bringing object glasses into figure.

The result was the Rumford prize was awarded me for a method of local correction. Upon the occasion of its presentation, the Academy meeting was attended by Dr. Bigelow. The president, Professor Asa Gray, stated the grounds on which the award was made, and I replied as well as I could. Charles G. Loring and Dr. Bigelow were seated near, and I heard one say to the other, "that was well done." After the adjournment I reminded Dr. Bigelow of his saying that if I wished to learn to make telescopes I must go where they make them, and added that I had been. "Have you, where?" Cambridgeport was my reply.

I met Dr. Hare at the August meeting of scientists at Albany in 1856. Finding him soon after in Boston, I invited him to sit for a portrait, which I finally sold to Dr. Henry for $100.*

So you will perceive that the three periods of my life of

* This was Professor Joseph Henry, Secretary or Director of the Smithsonian Institution at Washington, where the portrait is still preserved.—W. A. R.

which you write, have been considerably blended. Lives thus changeful are frequently troubled in their finances, but I have been fortunate enough to meet my money promises all along, and have a fair reserve for a rainy day.

I have received the degree of A. M. from Amherst, Chicago, Princeton and Harvard. I have read much popular astronomy, but in its mathematics I am lamentably deficient. You will see by the printed papers I shall send with this that I have made some use of telescopes. I have lived to see the companion of μ *Herculis* therein mentioned go through considerably more than half a revolution.

This is the most of an autobiography I have ever prepared, and my condition is such that I shall probably never make another attempt, so I would like you to preserve this after selecting your points, for some of the Ashfield people may be pleased to see it. Let me know at once if it is safely received, and when you puplish send me a copy of your production.

I will add further what may be of interest. I have always voted with the Republicans when voting at all since they came into power, but have never attended caucuses or held an office. I have never been a church member, nor had either of my parents, but my faith in the universality of God's providence is entire and unswerving. My grandfathers died one at 87, and the other 88. I knew them well, and they were good men. Both had been engaged in killing whales.—I have never heard of one of my progenitors —Thomas Clark* of the Mayflower was one—as being a bankrupt, or grossly intemperate.—I was never but once sued, and in that case employed Joel Giles as counsel, who made a compromise without going to trial. I never sued but one man, and that was Collector Austin, and I gained my case. I never studied music or attended an opera in my life, and know nothing of chess or card playing.—I never learned to dance, but was a good swimmer, though lacking generally in the points which go to make an expert gymnast.—I have long been a member of the American Academy of Arts and Sciences, and my son G. B. enjoys the same honor more recently conferred.

I hope the above will serve your purpose.

Yours with great esteem,

ALVAN CLARK.

* From whom Clark's Island, near Plymouth, takes its name.

TOTAL SOLAR ECLIPSE, JAN. 1, 1889.

PROFESSOR WINSLOW UPTON.*

For THE MESSENGER.

The following account of the observations made at Willows, California, by Mr. A. L. Rotch, proprietor of the Blue Hill Observatory, and myself may be of interest.

We located at Willows, California, about 2,700 feet W. N. W. of the station occupied by the Harvard Observatory party. Our selection of Willows was by invitation of the Harvard party, and our observations supplement those made by Mr. Pickering and his assistants. We were obliged to go to a different part of the town, however, to secure proper exposure of the wind instrument. The observations planned were chiefly to detect the atmospheric fluctuations caused by the withdrawal of the sun's heat, and to observe the shadow bands.

The instrumental equipment consisted of three sensitive aneroid barometers and one self-registering barograph, wet and dry-bulb thermometers, self-registering maximum and mimimum thermometers of special sensitiveness, a pair of black and bright bulb thermometers in vacuo to determine the solar radiation, a self-registering Violle actinometer, a self-registering anemometer of the Robinson pattern and a sensitive self-registering wind vane. Besides these meteorological instruments were a field chronograph, a three-inch-telescope and a small camera. The wind and radiation instruments were mounted upon the railing of a tower about forty feet above the ground, and the suitable exposure of all the instruments was carefully secured.

The observations consisted of five minute readings of all the meteorological instruments except those which were self-registering. During totality a 60-second exposure was made, the camera pointed upon a newspaper fifteen feet from it, in order to determine the brightness of the sky during the eclipse, as requested by Professor Todd. Special attention was given to the shadow bands, both observers and two others joining in this part of the work. Part of the plan was an attempt to photograph them for which purpose

* Professor of Astronomy in Brown University, Providence, R. I.

two large white screens were erected, one vertical, the other inclined 45°, 27 feet from the camera. The contacts were observed and sketches of the corona made.

The results of work may be stated summarily as follows: The temperature fell 5° and reached its lowest point ten minutes after the total phase; the humidity rose thirty per cent; the dew fall was not appreciable on the ground, but papers were perceptibly dampened; the barometric pressure fell and rose but nearly in the usual diurnal curve; the wind died down nearly calm, and increased after totality; its direction, which was north, suffered a slight deflection towards the west near the time of the total phase. All of these effects can be ascribed to the eclipse. The shadow band observations were not as successful as had been hoped. Besides the white screens mentioned above, white sheets were spread upon the ground, and all four observers watched for them carefully both before and after the total phase, while one observer watched for them also during totality. The writer was the only one of the observers who saw them at all, and his view was a mere glimpse thirty-four seconds before the beginning of totality. They were about an inch wide and 3 to 4 inches apart, apparently stationary, and were seen upon the vertical screen towards which the camera was pointed. An exposure of one-fifth second was made. The plate on development showed no sign of the bands, but the fact that the screens are well defined and also the shadow of a tree upon them shows that the photographic power of the light, even so near totality, is remarkably strong. The plates used were Seed plates, very sensitive.

The shadow band observations were made in accordance with a plan by which records of the same kind were to be secured at a number of stations, as explained in a circular which had been widely distributed. Fourteen reports have been received. It is shown by them that the bands in this eclipse were faint and narrow. The estimates of velocity are various but all the reports agree in assigning the direction in which they lay before the total phase as N.E. to S.W. Other interesting facts will be brought out when the records are discussed.

The first contact was lost from clouds; the others were

carefully observed and the comparison with the times calculated from the date in the American Ephemeris is as follows:

	CALCULATED. h m s	OBSERVED. m s
Second contact	1 47 46	47 48.5
Third contact	1 49 42	49 47.0
Fourth contact	3 7 46	7 43.5

During totality it was perfectly easy to read the seconds dial of a white watch face, and the brightness was about that 20 minutes after sunset on the same evening. The sky was perfeetly clear in the region occupied by the sun during the time of totality and the corona observed under specially favorable conditions.

TOTAL SOLAR ECILPSE REPORT.

J. A. BRASHEAR.

For the MESSENGER.

I am not certain that my work on the eclipse is of any great value. I decided to go at such a late date, that I had little time to prepare for it; in fact, four days before starting I had no telescope; in that brief period I had a 4⅛-inch refractor ready for shipment. It is perhaps as fine a glass as we have ever turned out, and Mr. Burckhalter would not let me bring it away from San Francisco, but kept it "right there" as he enthusiastically said. At the request of Professor Very, of the Allegheny Observatory, I made as nearly as I could, a sketch of the south polar corona, confining my work to that alone, though I was tempted by the beauty of the scene to drop pencil and look. I believe it was of Professor Peters that the story is told, that he was asked what instruments he would take to the next eclipse and he replied "a pillow," and so I felt. Our station was at Winnemucca, and Professor Howe with Col. Maxson had made arrangements with Dr. Elkin, of Yale University Observatory and Mr. Henry Phipps of Allegheny. Col. Maxson's camp was about 1½ miles from the town where two tents were put up, and the instruments set. It is not necessary to give the names of the party for they have been published already.

The day dawn was exquisite. I had walked about four

miles from the town before sunrise to see the glorious orb of day come up from the eastern mountain range. I was not disappointed. I saw a sight never before witnessed. The color display around the sun was glorious; but all at once a column of the loveliest hues stood up before me with its apex in line with the sun, and its base, like that of the rainbow, resting in a "pot of gold" not far off yet ever receding as I advanced. I found it was caused by ice crystals that were being driven to the westward by a gentle breeze, and the dark background of the mountain bringing it out in glorious relief. But this is not the eclipse of the sun, is it? Well, everything was ready by the time the moon was to put in an appearance. In order to help Professor Howe I took first and last contact, rating my watch from his chronometer, which was corrected from signals from Lick Observatory. My first contact was a little slow, perhaps two seconds, as I was carefully watching to see if I could not catch the moon's limb projected on the solar corona. The point of first contact being a little high in the field I did not see the limb of the moon until contact, although I do think it should have been seen in that exquisite atmosphere. I had an excellent polarizing helioscope with me, and as the moon's limb advanced on the sun's disc the projection of the lunar mountains, presumed to be the Doerful Mts., was clear cut and well defined as I ever saw them, and the granular surface of the sun came out beautifully. Professor Howe and Mr. Davidson coincided with me in this, after observing it with the four-inch telescope, using the polarizing eye-piece.

As totality approached, my sketching arrangements were made ready and consisted of a piece of plate glass half of which was finely ground and the other half left plain, the line between the two being a curve representing the limb of the moon. This made a splendid sketching plate when it was feebly illuminated by a lamp behind it and it could be used as a photographic negative reproducing in white the black pencil lines. I had practiced sketching frost crystals rapidly and when totality brought out the delicate structure of the polar corona I did my best to sketch the finer detail of the south polar corona, at the same time outlining the two beautiful protuberances that were at either edge of the field, one of which was very interesting from the fact that a

tongue of flame had become detatched from that part resting on the sun's limb.

The chromosphere was observed in all its gorgeousness and simply outlined, as I stuck to my task of sketching a few degrees of the south polar corona.

After the appearance of the sun I shifted the telescope so as to observe how long I could see the coronal fringe. I was certain I saw it well for half a minute, and the hazy light could be seen for some seconds afterwards. The last contact agreed with Professor Howe's observation within half a second.

Finally I must say that the good people of Winnemucca were very kind, and Col. Maxson did all he could to make the work of the party a success, and the eclipse of Jan. 1, 1889 will long be remembered. Professor Howe is an enthusiastic man, and he will succeed. Dr. Elkin was not well, so he observed at the hotel.

WASHINGTON UNIVERSITY ECLIPSE PARTY.

PROFESSOR C. M. CHARROPIN.*

The party from St. Louis was composed of Professor Pritchett, in charge of the Washington University party, and Professors Nipher and Engler of that University and myself. We had been provided with all necessary instruments for making the observations, some of which had been kindly placed at our disposal by the government, and all these had been sent on before, and we went with the determination of making the most of the splendid opportunity that was open to us, providing there should be no clouds or hazy atmosphere to interfere with the observations. Professor Pritchett had determined to make Norman as our observing station, this being considered the most favorable spot in the Sacramento valley. We had sent our instruments to Willows, but we were unwilling to settle at that point, the station being already occupied by Professor Pickering and party of Harvard College.

* Department of Chemistry and Astronomy of the St. Louis University, St. Louis, Mo.

At Willows we were kindly received by Professor Pickering, who invited us to his station. We found him well equipped, with two 13-inch telescopes equatorially mounted, spectroscopes, cameras, etc.

Early next morning we were at the railroad station, but to our great disappointment we were informed that the freight train was six hours behind time. Professor Engler, who had an eye to business, perceived a locomotive and he at once telegraphed to the superintendent at Sacramento for the use of the locomotive to pull our freight car to Norman. A quarter of an hour later a message from Sacramento announced that our request had been granted. Through the kindness of the superintendent we were landed safely at Norman about 9 o'clock A. M., and here I must acknowledge the great kindness of the railroad men all along the line.

The remainder of the day was spent in building sheds and placing our telescopes in position. We were all delighted with our station; a beautiful little cottage with roses in bloom in front of the house, good-hearted and jovial companions; our location on the very center of totality; no one to disturb us we formed a happy little family. Professor Valle of the University of Tacubaya, just outside the City of Mexico, had joined our party, and his services were valuable to us. Five days of preparation were left us, and not a minute of time was lost. Professor Pritchett had assigned to each astronomer his special task. Our astronomical clock at first refused to do its duty, but under the control of Professor Nipher it soon learned to obey. Many photographs were taken to test the power of the government lenses, and we obtained very fair negatives of the crescent moon, of the sun, of Venus and other celestial objects, and terrestrial scenes were also photographed. The camera I had brought along did not remain idle. We obtained good negatives of the station, of the instruments, the surrounding mountains, etc. Even an instantaneous shot at a flock of wild geese left its impression on the sensitive plate. Finally the great day came. Our preparations were complete and our exact latitude and longitude had been determined by many observations. But a cloudy sky seemed to cast a gloom on the faces of the observers; one alone appeared to be confident of success.

The supreme moment approached. Each astronomer was at his post; a solemn silence prevailed. The sun peeped through the clouds, but soon was veiled again.

"Time!" called the observer at the chronometer. The first contact was lost.

The look of anxiety depicted on the contenance of every observer would have been a fit subject for the camera, but the camera was idle. Few words were exchanged, but our silence spoke volumes.

A special train then arrived from San Francisco. Mr. Rideout and family, Senator Boggs and many friends were present. A sumptuous lunch had been prepared, but the astronomers had no appetite. Clouds on clouds swept over the sun, the darkness now became apparent; nature assumed an unearthly appearance; a greenish, awe-inspiring light shone on the tips of the neighboring mountains. Suddenly the clouds opened, the sun and moon appeared in a clear blue sky. A shout of joy and admiration burst forth from every pair of lungs. The last lingering ray of the sun disappeared; the corona burst forth in all its glory and majesty; four planets and many stars shone brightly. A perfect silence followed, disturbed only by our astronomical clock beating the half seconds.

Our observations were very successful, Bailey's beads were distinctly seen. We have six excellent negatives of the corona, showing all the details of the streamers of the outer corona Six protuberances are distinctly marked. These red flames of hydrogen, being nonactinic, were supposed to be beyond the reach of a gelatine plate during a short exposure, but, thanks to Mr. Seed, who had made a special emulsion for the eclipse party and furnished us with excellent plates, our success was beyond all expectation.

After shakings of hands and mutual congratulations, we packed carefully our instruments and left for San Francisco on the following day. There Professor Prichett gave to his party, at the Palace Hotel, a grand eclipse dinner. The same evening the party left for Mount Hamilton. Sickness detained me two days at Santa Clara College. From the college I could see the Lick Observatory over-towering the clouds. It was painful to an astronomer to see at a distance the land of promise and not be able to enter it. My party

could not wait for me. They started with a heavy rain, spent two days at Mount Hamilton well impressed with the grandeur of the monster telescope, but the seeing was poor on account of the bad weather. Returning, they met me climbing up the slope with a team of two fine horses. In a bee-line the Lick Observatory is 13 miles from San José, our starting point. But the road, which is like "a wounded snake dragging its slow length along," is 27 miles. After a ride of six hours I arrived at the Observatory. The scenery is gorgeous. The deep canyon; the brilliant effects of a rising sun on distant mountains; the snow-capped Sierra Nevadas 200 miles away; the deep valleys covered with a carpet of green grass, are descriptions which belong to the poet and should be left untouched by the astronomer.

Professor Holden, who is not only a great astronomer, but a scholar and a perfect gentleman, received me with the greatest cordiality. He gave me the use of the great telescope for two hours. From 12 midnight to 2 o'clock in the morning I feasted my eyes on celestial objects.

The night was clear and beautiful, Saturn was a beautiful object. It appeared much larger in the telescope than the moon appears to the naked eye. The markings on the sphere of the planet were well defined and extended almost to the poles. Seven moons shone brightly, but coy Mimas was hidden behind the old god. The nebula in Orion was another object of great interest, but it baffles all description. The six stars of the Trapezium were separated, and the "Nova," Alvan Clark's star was barely visible. Nebulous matter extended far beyond the field of the telescope. I next observed double stars and nebulæ, objects familiar to me, but how differently they now appeared. How insignificant to me is my small telescope which but lately I prized so much. The large telescope weighs 10 tons, and yet it is so well balanced that I could move it with one hand. At 2 o'clock A. M. Professor Schæberle brought me to my room. After a good rest and a hearty breakfast Professor Holden brought me to his sanctum. He showed me excellent photographs of the moon, the work of Professors Burnham and Barnard, who are excellent artists as well as good astronomers. I had a long talk with Professor Holden, whose conversation is both interesting and instructive. The next

part of the program was to climb up the hill. We formed a party of three, Professor Swift of Rochester, N. Y., Professor Barnard, the discoverer of twelve comets, and myself. We visited Mount Copernicus, Mount Galileo and Mount Keppler. From the last named we had a sight of the Pacific Ocean, fifty miles distant. Professor Barnard was our leader. He climbed up the steep cliffs like a deer, encouraging us to follow him by both word and example. A more genial companion than Professor Barnard I never met before. It is difficult to say what is to be admired more in him —the efficient astronomer, the refined gentleman or the genial companion who seems to forget himself in order to make his guests happy. The remembrance of Mount Hamilton shall not soon fade from my memory.

AMATEUR ASTRONOMY.

The friendly relations which were established between the professional astronomers at Mount Hamilton and the amateur photographers and amateur astronomers of San José and coast on the occasion of the recent eclipse of the sun have almost spontaneously resulted in the formation of an astronomical association. Just prior to the eclipse a pamphlet of information relative to it was issued from the Lick Observatory, and was widely read and followed by the many photographers and amateur astronomers, and the community of interests led to friendly relations and intercourse. During the first week of last month these culminated in the initiatory steps being taken toward the formation of the Astronomical Society of the Pacific Coast, as first suggested in the field on January 1st. The meeting was immediately followed by a discussion of the constitution and by-laws of the new association referred to.

The following temporary officers were elected to hold office until the the annual election of officers, which will be held on the last Saturday in next month: Edward S. Holden, president; J. M. Schæberle, vice-president; C. Burckhalter, secretary; E. J. Molera, treasurer. The newly elected officers at once agreed to issue a circular inviting all who take a genuine interest in astronomy to join the society. The circular

which was adopted sets forth that meetings shall be held part of the year in San José and the remaining portion at Mount Hamilton Observatory; and that a journal devoted to the astronomical interests of the coast and the diffusion of general knowledge on astronomy should be established. The names of thirty-four private individuals were set down as members, and copies of the circular will be at once forwarded to the members of the Academy of Sciences, the Technical Society, the Microscopical Society, the Geographical Society, the Historical Society of San Diego and other similiar bodies, as well as the various colleges and universities of the coast.

The constitution and by-laws were then discussed and adopted. The object of the society is therein set forth simply as the advancement of the science of astronomy. The headquarters of the society are to be in San José, and until suitable quarters have been obtained the annual meetings will be held on the last Saturday in March in the rooms of the Amateur Photographers' Association. Eleven directors will have control of the business of the society and special officers will be appointed and paid as such are required. An astronomical library is to be formed under the care of a librarian. The meetings will be held every two months, those in May, July and September in the library of the Lick Observatory, those in January, March and November in San José, all meetings being held on the last Saturday of each of the months named.

CURRENT INTERESTING CELESTIAL PHENOMENA.

THE PLANETS.

Mercury may be seen in the morning during the first half of March, rising in the southeast about an hour before the sun. During the latter part of this month and the whole of April he will be too near the rays of the sun and too far from the earth to be well seen. No doubt many of our readers noticed how conspicuous this planet was in the southwest after sunset during the first few days of February.

Venus will be at her greatest brilliancy March 25. No doubt many have noticed during the past month the percep-

tible shadows which are cast by objects in the light of this planet. The writer was considerably surprised a few evenings since, on opening the dome towards Venus, to notice the intensity of the shadows of the equatorial thrown upon the opposite wall of the dome. Several very fair telescopic views have been obtained but none when the seeing could be called perfect or even excellent. No markings could be detected on the illuminated half of the disk but the gradual shading off at the terminator, indicating twilight in the atmosphere of the planet, was very perceptible. Although the phase was only slightly gibbous, considerably more than half the disk was illuminated. Venus is easily visible in full sunlight during the afternoon. Several persons have written concerning their own observations, and the writer has several times, while walking across the college grounds, detected the planet by a single glance at that portion of the sky where it was known to be. The phase of Venus is diminishing rapidly, the illuminated portion of the disk being 0.356 March 15, 0.276 March 25, the time of greatest brilliancy, and 0.084 April 15, while the apparent diameter of the disk will increase from 33.2″ March 15 to 53.4″ April 15.

Mars, though still visible in the early evening a little west of Venus, is so distant from the earth that its apparent diameter is only 4.3″, so that no detail can be made out upon its surface.

Jupiter is coming in good position for observations in the morning and we give again the phenomena of the satellites which may be observed and the approximate times of transit of the great red spot across the center of the disk. An interesting report on the observations of Jupiter in 1887 and 1888, is given by Mr. W. F. Denning in the December, last, number of the Journal of the Liverpool Astronomical Society. Few observers have paid much attention to the red spot, but a long series of observations by Mr. A. Stanley Williams at Brighton gives for the rotation period of this spot 9*h* 55*m* 39.6*s* or 1*s* less than the period adopted in Mr. Marth's ephemeris. Eighteen observations of an equatorial white spot give for its period of rotation 9*h* 50*m* 28*s* or 5*m* 12*s* less than that of the red spot. Mr. Williams says: "A gradual change took place in the whole aspect of the

planet in the course of the opposition of 1888. Last year nearly all the equatorial spots both white and dark, were ranged along the south equatorial belt. In the latter part of the previous opposition corresponding white spots had formed by the north equatorial belt, opposite to nearly all the white equatorial spots by the south belt, the two opposed spots being generally connected by a white streak. Most of the dark equatorial spots south of the equator also had corresponding dark spots opposite to them, connected in many cases by dark streaks. The equatorial region then had a curious uniformity of appearance. A number of little dark spots also appeared in the equatorial belts, frequently connected by a faint dusky shade between the spots on the several belts. These were somewhat delicate features sometimes. When several sets of spots with their connecting shades were visible at once, the aspect was rather curious; the streaks on either side being, of course, curved, and appearing to radiate from the pole. The spots on these belts all had rotation periods approximating to that of the red spot." An occultation of Jupiter by the moon will occur on the morning of March 24, visible throughout the United States. The Washington times of beginning and end are given in the tables of occultations. Although this occultation will occur in sunlight or strong twilight at most points where it is visible, it may be observed without great difficulty with a telescope of moderate power. At Carleton College Observatory the duration will be 49 minutes for the center of the planet beginning at 5:14 and ending at 6:03 A. M., Central time.

Saturn will also come very near being occulted by the moon March 13 at midnight, his distance from the center of the moon as seen from the earth's center being only 60′ south. In northern latitudes the parallax of the moon will bring its southern edge very near to if not over the planet. Saturn is in excellent position for observation so that splendid views of the rings and the surface of the planet may be obtained on any clear night. In the *Monthly Notices* of the Royal Astronomical Society there is an interesting paper on "*Retrogradation of the Plane of Saturn's Rings*," in which the author gives a table of the times of disappearance and reappearance of Saturn's rings for the four epochs 1848-49,

1861-62, 1878 and 1891 and the recorded observations during the first three epochs. In 1891 there will be but one disappearance from September 23d 15.9*h* to November 2d 16.9*h*, Berlin mean time. The disappearance cannot be observed as the planet will be within a half hour from the sun, but there may be some chance for the reappearance, Nov. 2, when the planet will rise over two hours before the sun.

Uranus will be at opposition to the sun April 9, and therefore in good position for observation. It is to be hoped that the observers with the Lick telescope may be able to detect some marking upon this planet which will enable them to determine its period of rotation, about which we know nothing. Uranus may be found in the east, after 8 o'clock P. M., in Virgo about 3° north of Spica.

Neptune may still be seen in the early evening about 5° directly south of the Pleiades.

MERCURY.

	R. A.	Decl.	Rises.	Transits.	Sets.
	h m	° ′	h m	h m	h m
Mar. 20	22 25.2	−11 47	5 15 A.M	10 31.6 A.M.	3 48 P.M.
25	22 51.1	− 9 40	5 13 "	10 37.8 "	4 03 "
30	23 18.9	− 7 01	5 10 "	10 46.0 "	4 22 "
April 5	23 54.6	− 3 11	5 07 "	10 57.8 "	4 49 "
10	0 26.4	+ 0 30	5 04 "	11 09.9 "	5 15 "
15	1 02.3	+ 4 35	5 03 "	11 24.0 "	5 42 "

VENUS.

Mar. 25	2 43.7	+21 41	6 54 A.M.	2 29.9 P.M.	10 06 P.M.
April 5	2 57.8	+23 34	6 15 "	2 00.6 "	9 46 "
15	2 55.8	+23 38	5 34 "	1 19.3 "	9 05 "

MARS.

Mar. 25	1 41.9	+10 28	6 43 A.M.	1 28.3 P.M.	8 14 P.M.
April 5	2 13.0	+13 23	6 18 "	1 15.8 "	8 13 "
15	2 41.3	+15 48	5 57 "	1 04.8 "	8 13 "

JUPITER.

Mar. 25	18 29.9	−22 58	1 52 A.M.	6 18.1 A.M.	10 44 A.M.
April 5	18 33.6	−22 56	1 08 "	5 33.8 "	9 59 "
15	18 35.5	−22 55	12 30 "	4 56.3 "	9 22 "

SATURN.

Mar. 25	9 06.4	+17 50	1 34 P.M.	8 51.3 P.M.	4 09 A.M.
April 5	9 05.2	+17 54	12 49 "	8 07.0 "	3 25 "
15	9 05.0	+17 55	12 10 "	7 27.4 "	2 45 "

URANUS.

Mar. 25	13 17.0	− 7 26	7 27 P.M.	1 01.3 A.M.	6 35 A.M.
April 5	13 15.2	− 7 15	6 42 "	12 16.3 "	5 51 "
15	13 13.6	− 7 06	6 00 "	11 35.4 P.M.	5 11 "

NEPTUNE.

Mar. 25	3 53.0	+18 35	8 18 A.M	3 38.7 P.M.	10 59 P.M.
April 5	3 54.2	+18 39	7 36 "	2 56.7 "	10 18 "
15	3 55.5	+18 43	6 57 "	2 18.6 "	9 40 "

THE SUN.

	R. A. h m	Decl. ° ′	Rises. h m		Transits. h m		Sets. h m	
Mar. 20.....	0 01.3	+ 0 08	6 03	A.M.	12 07.4	P.M.	6 12	P.M.
25.....	0 19.4	+ 2 06	5 53	"	12 05.9	"	6 19	"
30.....	0 37.6	+ 4 03	5 44	"	12 04.4	"	6 25	"
April 5.....	0 59.5	+ 6 21	5 33	"	12 02.6	"	6 32	"
10.....	1 17.8	+ 8 13	5 24	"	12 01.2	"	6 38	"
15.....	1 36.2	+10 02	5 15	"	11 59.9	A.M.	6 44	"

Occultations Visible at Washington.

Date.	Star's Name.	Magnitude.	IMMERSION. Wash. Mean T. h m	Angle f'm N. P't. °	EMERSION. Wash. Mean T. h m	Angle f'm N. P't. °	Duration. h m
Mar. 18	80 Virginis	6	13 03	157	14 07	268	1 04
23	Jupiter		18 34	46	19 35	314	1 01
April 4	δ^3 Tauri	5	6 21	121	7 20	219	0 58

Phases of the Moon.

	Central Time. d h m	
Full Moon	March 17	5 47.2 A.M.
Last Quarter	" 24	12 54.4 A.M.
New Moon	" 31	5 37.4 A.M.
First Quarter	April 8	7 4.70 A.M.
Full Moon	" 15	4 18.6 P.M.

Phenomena of Jupiter's Satellites.

Central Time. d h m		Central Time. d h m	
March 18 2 44 A.M.	III Ec. Re.	April 2 3 03 A.M.	I Ec. Dis.
3 16 "	I Tr. In.	3 1 31 "	I Tr. In.
4 15 "	I Sh. Eg.	2 29 "	I Sh. Eg.
5 16 "	III Oc. Dis.	3 37 "	II Tr. In.
5 32 "	I Tr. Eg.	3 43 "	II Sh. Eg.
19 2 46 "	I Oc. Re.	3 47 "	I Tr. Eg.
25 3 53 "	I Sh. In.	5 3 03 "	III Tr. In.
3 54 "	II Ec. Dis.	9 4 56 "	I Ec. Dis.
4 14 "	III Ec. Dis.	10 2 07 "	I Sh. In.
5 00 "	I Tr. In.	3 23 "	I Tr. In.
26 4 40 "	I Oc. Re.	3 42 "	II Sh. In.
27 1 54 "	I Tr. Eg.	4 23 "	I Sh. Eg.
3 39 "	II Tr. Eg.	11 2 54 "	I Oc. Re.
29 1 53 "	III Tr. Eg.	12 1 53 "	III Sh. In.
		3 20 "	II Oc. Re.

Approximate Times of Transit of the Great Red Spot Across the Middle of Jupiter's Disk.

Central Time. d h m		Central Time. d h m		Central Time. h d m	
March 16 4 18	A. M.	March 27 8 21	A. M.	April 7 2 29	A.M.
17 12 09	"	28 4 13	"	8 8 16	"
18 5 56	"	29 12 04	"	9 4 07	"
19 1 48	"	30 5 51	"	10 9 54	"
20 7 35	"	31 1 42	"	11 5 45	"
21 3 26	"	April 1 7 30	A. M.	12 1 37	"
22 9 13	"	2 3 21	"	13 7 24	"
23 5 05	"	3 9 08	"	14 3 15	"
24 12 56	"	4 4 59	"	15 9 02	"
25 6 43	"	5 12 50	"		
26 2 34	"	6 6 38	"		

Elongations and Conjunctions of Saturn's Satellites.

[Central Time; E = Eastern elongation, W = Western elongation, S = Superior conjunction, I = Inferior conjunction.]

JAPETUS.

March 27, E April 16, I

TITAN.

	d	h			d	h			d	h	
March	17,	9	E	March	29,	7	S	April	10,	6	W
	21,	8	I	April	2,	6	E		14,	6	S
	25,	7	W		6,	6	I				

RHEA.

March	16,	1.9 A. M.	E	March	29,	2.8 P. M.	E	April	12,	4.0 A. M.	E
	20,	2.2 P. M.	E	April	3,	3.2 A. M.	E		16,	4.4 P. M.	E
	25,	2.5 A. M.	E		7,	3.6 P. M.	E				

DIONE.

March	17,	9.4 A. M.	E	March	28,	8.0 A. M.	E	April	8,	6.6 A. M.	E
	20,	3.4 A. M.	E		31,	1.6 A. M.	E		11,	12.3 A. M.	E
	22,	8.7 P. M.	E	April	2,	7.3 P. M.	E		13,	6.0 P. M.	E
	25,	2.3 P. M.	E		5,	12.9 P. M.	E				

TETHYS.

March	15,	8.9 P. M.	E	March	27,	4.7 A. M.	E	April	7,	12.5 P. M.	E
	17,	6.2 P. M.	E		29,	2.0 A. M.	E		9,	9.8 A. M.	E
	19,	3.5 P. M.	E		30,	11.3 P. M.	E		11,	7.1 A. M.	E
	21,	12.8 P. M.	E	April	1,	8.6 P. M.	E		13,	4.4 A. M.	E
	23,	10.1 A. M.	E		3,	5.9 P. M.	E		14,	1.8 A. M.	E
	25,	7.4 A. M.	E		5,	3.2 P. M.	E				

Ephemeris of Comet e 1888 (Barnard Sept. 2). From the second series of elements of Berberich as given in *A. N.* 2862, I have computed the following ephemeris for March:

	Gr. M. T.	R. A.			Dec.			Log. r	Log. Δ
		h	m	s	°	′			
Mar.	1.5	23	37	54	−2	53.1		0.2675	0.4486
	3.5		37	39	−2	43.3		0.2687	0.4510
	5.5		37	25	−2	33.5		0.2700	0.4532
	7.5		37	12	−2	24.0		0.2714	0.4552
	9.5		37	1	−2	14.8		0.2729	0.4570
	11.5		36	48	−2	5.6		0.2744	0.4585
	13.5		36	36	−1	55.9		0.2760	0.4598
	15.5		36	24	−1	46.4		0.2776	0.4608
	17.5		36	12	−1	37.0		0.2794	0.4617
	19.5		36	0	−1	27.8		0.2811	0.4623
	21.5		35	48	−1	18.5		0.2830	0.4627
	23.5		35	35	−1	9.4		0.2849	0.4628
	25.5		35	21	−1	0.3		0.2868	0.4628
	27.5		35	6	−0	51.2		0.2888	0.4625
	29.5		34	50	−0	42.2		0.2909	0.4620
	31.5		34	33	−0	33.3		0.2930	0.4613

The comet will be unfavorable for observation during most of the month, being so near the sun, but may possibly be seen near the beginning and end. On March 1 it will set about an hour later than the sun, being still an evening comet, but on March 31, it will rise about an hour earlier, having then become a morning comet.

It is worthy of remark that its apparent motion for the whole month is only between three and four minutes of time in R.A., and a little over two degrees in Declination, while its change in distance from the earth is only eight million miles and from the Sun, ten million miles.

Its distance from the earth increases, but with greater slowness, until March 23, when it begins to diminish.

O. C. WENDELL.

Harvard College Observatory, Feb. 16, 1889.

Ephemeris of Tempel's Comet 1873 (II.)

		R. A.		Dec.		Log. Δ
		h.	m.	°	′	
1889 Feb.	2	20	49	−18	28.5	0.3667
	6	21	4	17	53.5	0.3667
	10	21	18	17	14.7	0.3669
	14	21	32	16	32.4	0.3673
	18	21	46	15	46.9	0.3680
	22	22	0	14	58.6	0.3689
	26	22	14	14	7.7	0.3700
Mar.	2	22	27	13	14.7	0.3712
	6	22	41	12	19.9	0.3727
	10	22	54	11	23.7	0.3743
	14	23	7	10	26.4	0.3760
	18	23	19	9	28.3	0.3779
	22	23	32	8	29.8	0.3799
	26	23	44	7	31.1	0.3819
	30	23	56	6	32.6	0.3841
April	3	0	7	5	34.5	0.3863
	7	0	19	4	37.0	0.3885
	11	0	30	3	40.4	0.3907
	15	0	41	2	44.8	0.3929
	19	0	52	1	50.5	0.3951
	23	1	3	0	57.0	0.3972
	27	1	13	−0	6.1	0.3993

Mr. George A. Hill of Washington, D. C., kindly furnished the above ephemeris of this expected comet. He says in an accompanying note, "After looking over the ephemeris, I am lead to believe that the comet will not be found until some time in March or April, as it is moving almost in the same right ascension as the sun. Yet the ephemeris will be of value to comet-seekers who do not have the use of foreign publications and receive the MESSENGER." Speaking of the late eclipse Mr. Hill says. "I caught the first contact at 4^h 28^m 32.3s Washington mean time, using my 3-inch refractor; the sun's limb was very unsteady and I may have been one or two seconds slow."

We also notice with interest that Mr. Hill and Mr. Tuttle

have been searching carefully for the Brooks' comet discovered Jan. 15. The observing was not favorable in January until the last day but one. On the morning of that day Mr. Hill made a very thorough search, by the aid of his 6¼-inch reflector, covering a space of 25° in declination, near its supposed place, but was unsuccessful in finding it. He thinks the comet can not be in the region of his search, or is too faint for his telescope.

Minor Planets. A minor planet of the 13th magnitude, or fainter was discovered at Nice Jan. 28.5337, in R. A. 9*h* 40*m* 11.3*s*, Decl. +11°46′33″; daily motion, minus 54*s*; north 10′.

Another new minor planet of the 12th magnitude was discovered at Nice Feb. 8.3942, in R. A. 9*h* 40*m* 52.7*s*; Decl. +10°19″23″; daily motion in R. A. doubtful; in Decl. 2*m* north.

EDITORIAL NOTES.

Large space is given in this number to reports of the late total solar eclipse by various parties. Mr. Burckhalter's account is an instructive one, and the prints of the negatives taken during totality which we have seen, were very good. The illustrations accompanying his article are inferior to the prints, and the prints must be inferior to the original negatives, for any one acquainted with the process of making prints knows that the fine details of the negative cannot be perfectly transferred. Our engraver ought to have done better work from the copy, but it is our misfortune that such work must be done without personal oversight.

The six cuts given on one page in Mr. Burckhalter's report are to show what good, small cameras will do. All of those prints with small image are good, some excellent, and this ought to encourage the amateurs to pursue this branch of study perseveringly.

The report of Carleton College party is defered till next month because of the failure of the engraver to finish the cuts in time.

C. W. Irish, Surveyor General of Nevada has furnished the MESSENGER an important report of his observations of the eclipse, accompanying the same with drawings and photographs taken during the eclipse. This report will also appear next month.

It will be a source of gratification to the friends of this journal to know that before the second month of 1889 had ended, the number of subscribers to the MESSENGER was forty per cent greater than on any previous year in its history.

Speaking of the brightness of the planet Venus, last month, we inadvertently ventured the opinion that a person must have pretty good vision to see that gem of the sky with the naked eye at one o'clock in the afternoon. We were suddenly and rightly called to account for such a statement by observers in Canada and in the United States. The truth is we had not noticed that Venus passed the perihelion of her orbit and greatest eastern elongation at nearly the same time. Of course the planet ought to be seen, then, near mid-day, if ever, north declination being favorable.

Satellites of Uranus. In a recent letter Mr. S. S. Chevers of Bridgeport, N. J., says: "While in Utah, at an elevation of 5,500 feet, I had some superb observations with my 3-inch telescope bought of Mr. Knipe, of Jas. W. Queen & Co., Philadelphia recently. Here in New Jersey I have caught a glimpse of the satellites of Uranus more than once. The glass is of French make and has proved most excellent in definition and power.

The Seven Eclipse Question. I am greatly obliged to Mr. Prentiss for his reply to my question concerning "Seven Eclipses in one year," and I might concede that the question is fairly answered. But he obtains seven eclipses in 1823 by a mere "scratch," since it depends on the longitude of a place whether his last eclipse of that year occurred in 1823 or 1824. And I would call attention to the remarkable coincidence that his seven eclipses in 1805 depend on a similar chance at the beginning of the year. American almanacs had only six eclipses in 1805, but announced a solar eclipse on December 31st, 1804, at about 8 P. M. at Boston which to European

countries would bring the eclipse on January 1st, 1805, giving them the seven eclipses in that year; and I find, on referring to my catalogue of eclipses that I had already noted this curious circumstance.

I should hardly say that we have found a fair answer to the question; it is a very strange thing that the only two instances in this century of "seven eclipses in one year" should both depend on so close an accident as above noted.

Evidently one will have to go back a good ways further than 1805 to find seven eclipses undoubtedly in any one year! *Query:*—How far back? And who can verify Mr. Prentiss' suggestion that the next "Seven Eclipse year" is 1917?

This is not a matter of great importance, but I mentioned it as of considerable interest, especially to the amateur and the untechnical reader. F. H. BURGESS.

The Next Total Solar Eclipse. Of a similar character is the question always asked, when a total eclipse passes, when will the next one take place? Some one has lately asked the *Scientific American* when there will be a total eclipse of the sun visible in the vicinity of New York. Probably the eclipse of May 28, 1900 fills the conditions fairly well. This eclipse begins in the Pacific Ocean, covers Mexico, enters the United States in Southern Texas, is total at New Orleans, the path of totality passes over Alabama, Georgia, the Carolinas, leaving the land near Albemarle Sound in longitude 76°4′ west from Greenwich, latitude 36°45′ north. The duration of totality will be 1 minute and 39 seconds. Its course will continue some distance northeasterly over the ocean, then turn southeasterly entering Portugal near Ovar, crossing Spain and the Mediterranean Sea and leave the earth in Africa. The track of totality is on the sea when nearest New York, being 200 or 300 miles distant. At New Orleans totality occurs at 7 o'clock A. M. and lasts 39 seconds.

I suspect it will be many years before New York City will have a larger eclipse than this. F. H. BURGESS.

St. Louis, Feb. 19th, 1889.

Methods of Tracing Constellations. An important illustrated article, titled, Methods of Tracing Constellations, is in hand from the pen of Professor William A. Rogers of Colby University, Waterville, Me. It will appear next month.

Astronomical Bibliography. William C. Winlock of the United States Naval Observatory kindly calls our attention to the fact that some work in the line of a current account of astronomical bibliography might prove an interesting and useful feature for the MESSENGER. Of course we say, yes, to that most heartily, and accordingly have urgently solicited Mr. Winlock to furnish the matter, knowing as we do that he has given careful attention to this kind of work for years past, and that few other American astronomers, if any, are ready to do it so well. This new feature will begin in the May or June number, or as soon as Mr. Winlock is through with the Smithsonian Review of Astronomy for 1887 and 1888 on which he is now engaged.

Error in Klein's New Star Atlas, Nebula 4415. Our attention is called by a friend to an error in Dr. Klein's new Star Atlas, on page 58, *Nebula in Draco*, 4415; Dr. Dreyer's C. G. 6643. In Klein's Atlas it is stated "According to Tuttle *it is variable in brilliancy*." Also in the last part of the note, it is said that "Tuttle's nebula was so brilliant and remarkable in the finder, that he was convinced that it had increased in brilliance since *J. Herschel and his father observed it*." The italic portions of the two quotations are erroneous. By referring to Dr. Dreyer's catalogue, it will be seen, that the first sentence ought to read: "6643, Discovered by Tuttle Sept. 8, 1863, and it would appear to be variable for M. d'Arrest says (in a letter May 8, 1863)," etc. The second error cited above is a wrong translation of d'Arrest's letter to John Herschel which is given in French, in Dreyer's catalogue. It should read: "Tuttle's nebula was so brilliant and remarkable in the finder that he was convinced that it had increased in brilliance since the time of Messior, and your father's and your own observations."

Partial Eclipse of the Moon Jan. 16, 1889. This eclipse was observed with the 12-inch equatorial. The first contact with the shadow was recorded as also were the bisections of prominent craters by the edge of the shadow. The recorded times are Standard Pacific Time and are eight hours slow of Greenwich. *7h* 58.7*m* the limb begins rather suddenly to darken as if entering a dense shadow;

8*h* 59.7*m* the limb is decidedly in the shadow; 8*h* 10*m*, pale red at the obscured limb; 8*h* 15*m*, the limb and the disc for about 2′ of a pale reddish yellow color. 8*h* 21*m* 12*s*, bisection of Tycho by shadow. At this time the yellowish color of the immersed part of the disc is decidedly unsymmetrical with reference to the edge of shadow—the coloring extending more to the s. p. 8*h* 29*m*, the light yellow coloring extends as far as Tycho. 8*h* 31*m* 17*s*, Kepler bisected by the shadow. 8*h* 43*m* 32*s*, Copernicus bisected by the shadow. 8*h* 48*m* 27*s* Aristarchus bisected. 9*h* 5*m*, about one half of the obscured portion of a dullish red; from this to the edge of shadow it is a beautiful steel blue. 9*h* 27*m* 27*s*, Aristarchus bisected, shadow leaving. 9*h* 32*m*, the red color is unsymmetrical with reference to the edge of shadow; it is now deeper red to the s. f. 9*h* 56*m* 42*s*, Copernicus bisected by the receding shadow. At this time the Mare Crisium was also bisected by the shadow. The obscured portion of the moon was conspicuous to the naked eye throughout nearly all the eclipse, and appeared of a lightish red color. Nothing specially noteworthy was seen. The color being probably about as decided as at the same stages in the eclipse of July 22, 1888. The edge of the shadow was moderately well defined. The prominent objects were easily seen within the shadow. E. E. BARNARD.

Lick Observatory, Mt. Hamilton, Cal.

The Peters-Borst Star Catalogue. On the last day of January, the case of Dr. C. H. F. Peters, Director of the Litchfield Observatory of Hamilton College, Clinton, N. Y., against Mr. Charles A. Borst, Fellow at Johns Hopkins University, to obtain possession of the manuscript containing the places of over 30,000 stars, arranged for a star catalogue, came up for hearing before Judge Williams, in the Supreme Court at Utica, New York. This manuscript was made by Mr. Borst, aided by his sisters, during his connection with Litchfield Observatory, apparently in the capacity of assistant to Dr. Peters, beginning it in the year 1884, three years after he entered the Observatory in this capacity. As reported by a correspondent to the New York *Evening Post*, the manuscript in dispute contains the position of 35,608 stars reduced to the epochs of 1850 or 1875, and arranged in the

order of their right ascensions. These positions have been gathered from various sources of information covering a period of the last fifty years, and every place chosen has been verified. The amonnt of work involved in such an undertaking is simply enormous, and no one can appreciate it who has not been similarly employed.

A general idea of it may be conveyed by a brief numerical statement taken from the same source as cited above. The manuscript of the catalogue numbers 3,572 pages, 900 of which are nearly double folio size, and bear on their face upwards of 7,000,000 figures. More than half of the computations, it is claimed, was made by Miss Emma Borst, and that all the annual precessions were computed by her. Nearly 1,000 pages of the catalogue is in the hand writing of Miss Lucy Borst.

Dr. Peters claims that Mr. Borst did the work of compilation and computation while he was working at the Litchfield Observatory, on a salary paid by himself, and that therefore the property belongs to him.

On the other hand Mr. Borst claims, that he did the work on the catalogue outside of his labors at the Observatory, and that most of the computations were made by persons at his request, without Dr. Peters having anything to do with them.

The importance of this case in the minds of the parties is seen in the reputation of the witnesses called, two of which were Professor L. Boss, Director of Dudley Observatory, Albany, N. Y., and Professor Asaph Hall, U. S. Naval Observatory, Washington, D. C.

Their evidence was secured to aid in determining the point of ownership and the cost of such work. In the testimony of those distinguished astronomers the cost of this work was claimed to be $15,000, certainly not less than $12,000. The cost of publication of it and the limited sale that such a catalogue would have, in the general market, would make the work one undertaken chiefly in the interest of science and for the reputation of those doing it. We have not, at this writing, learned whether the case has yet been decided or not.

A Large Meteor is said to have fallen in Orange county, New York. The report claims that it was very brilliant,

yellow tinged with green, and that "*bursting showered gravel stones over an acre of ground!* We would like to buy that acre of ground.

Rowland's Photographic Maps of the Solar Spectrum. A new and improved edition of Rowland's Photographic Maps of the solar spectrum from the extreme ultra violet down to, and including B, to wave length 6950 is now ready. This new series of maps was made from new gratings ruled by a new engine. It is claimed that the new gratings give definition much superior to any before made at the laboratory of Johns Hopkins University, although some of this better definition is lost in the photographic process of enlargement, which difficulty the photographic art does not yet know how to overcome. The original negatives show E, and even finer lines like that at wave lengths 5276.1 and 5914.3, plainly double, but there is little hope of showing this in the map. These maps, in general, are the same in form and mounting as the old ones, but are to be sold at a somewhat higher price, on account of the necessary increase of cost in making them.

New Astronomer Royal for Scotland. The January *Journal* of the Liverpool Astronomical Society says: "The Queen has been pleased, on the recommendation of the Secretary of Scotland, to appoint Mr. Ralph Copeland, Ph. Doc., F.R.A.S. to be Astronomer Royal of Scotland, and Professor of Practical Astronomy in the University of Edinburgh, in the room of Professor Piazzi Smyth, resigned." For the last fifteen years Dr. Copeland has been at the Dun Echt Observatory, and his work during this time has been well known and esteemed of high order. Dr. Copeland is now between fifty and sixty years of age.

Annuaire de l' Obsevatoire Royal of Brussels for 1889 is at hand by the kindness of Director F. Folie. In general appearance it is a companion of previous volumes, but also presents interesting records peculiar to the year 1887. The illustrations of sun spots observed in June, July and August of that year are skillfully represented. Other solar studies are also interesting.

Editor of Knowledge. We notice with pleasure that A. Cowper Ranyard, M. A., F. R. A. S., takes the position of Editor of *Knowledge* since Mr. Proctor's decease. Its sustained vigor and excellent contents do its new management honor, and will doubtless bring to it deservingly increased success.

Annals of the Cape Observatory. Part 2, Vol. II, of the Annals of the Cape Observatory contains a thorough study of the variations of the instrumental adjustments of the Cape Transit Circle by W. H. Finlay, M. A., chief assistant. There is so much of value in this paper that another occasion must be taken to speak of the salient points.

Haynaldo Observatorium. A report for the year 1888 is on our table. The greater part of the report is given to records of the chromosphere of the sun, and observations of the protuberances for the year 1886.

Foreign periodicals mention the interesting fact that Mr. Isaac Roberts of Dunsink Observatory has presented his reflecting telescope of fifteen inches aperture to that Observatory. This instrument is to be used in the study of stellar parallax by the photographic method.

The Roberts' Photograph of the Great Nebula of Andromeda. Mr Isaac Roberts, of Dunsink Observatory, photographed the great Nebula of Andromeda, Dec. 29, 1888, with an exposure of four hours. As he himself truly says: "It is now seen for the first time in an intelligible form." The best drawings of this object previously known to astronomy were by Bond and Trouvelot. These observers pictured it as a long, irregular mass, with two nearly straight rifts and a prominent nucleus.

Roberts' fine photograph brings out clearly its grand oval form with condensed center and other nuclei and the two dark spaces gently curved and concentrically placed, giving to the nebula a beauty and symmetry of form undreamed of before. The MESSENGER congratulates Mr. Roberts on this noble victory by the photographic art.

Mr. Croll's Theory of Climate. After the appearance of my note in the MESSENGER on this subject, Mr. C., in answer to the inquiry why he had not replied to Woeikoff's objections, wrote that the gentleman had evidently not "grasped the question at all." Similarly, one who thinks that *time* is not an element of the problem, has yet to advance a long way before coming up to Woeikoff's position, at least such is my opinion. R. W. MCFARLAND.

Oxford, O., Feb. 1889.

BOOK NOTICES.

Star Atlas Containing Maps of All the Stars from 1 to 6.5 Magnitude between the North Pole and 34° South Declination, and of all Nebulæ and Star Clusters in the Same Region which are Visible in Telescopes with Moderate Powers. By Dr. Herman J. Klein. Translated and adapted for English readers by Edmund McClure, M. A., M. R. I. A. With eighteen maps. New York: Messrs. E. & J. B. Young & Co., Publishers. 1888.

This new star atlas is a pleasant surprise to us. We did not before know that Heis had any such rival for real merit in existence. We desire to call special attention to a few points which seem meritorious after a somewhat careful examination. The printed page is 10 inches by 5¾ inches, with a good margin, the covers being 9 by 11¾ inches. The table of contents fills six of these large pages. In it the constellations are arranged in alphabetical order, the name of each being printed in a heavy-faced letter, and after it all the prominent objects of the constellation with reference to the page in the subsequent part of the atlas where a detailed description of the object will be found. As an illustration, under the constellation *Lyra*, α Lyræ is the first object named, with reference to page 59, where we read: "This splendid star, 1 mag., has near it several faint stars, but their connection with it is merely optical. One of them which was used by Struve and Brünnow as a comparison star for cataloguing the parallax of Vega, is of 9.5 mag. $d = 48''$, $p = 156°$, another of 9 mag., $d = 150''$, $p = 40°$. Winnecke and Burnham have also measured a very faint star (13 mag.), $d = 52''$, $p = 292°$." This illustration is about the average of others in length, and, as to quality, speaks plainly for itself.

After the index follows the introduction, covering ten

pages, in which are given, first, tables for converting sidereal time into degrees and *vice versa*; a table showing the sidereal time of mean noon for every day in the year, and then follows brief articles on the constellations, magnitudes of the stars, number of the fixed stars, double stars, star clusters, nebulæ, explanation of the maps, and general description of the catalogue of interesting celestial objects that follows and fills 61 pages.

This catalogue is one of the excellent features of the atlas. On the left hand side of each page are two vertical columns, each about one inch in width, which give the right ascension and declination of every object on the page for the epoch of 1880. The entire catalogue is arranged in the order of the right ascensions of the objects it contains, each page giving on the average about ten objects, or more than six hundred in all. The references in this catalogue come down as late as August of last year, as shown by notes relating to Professor A. Hall's paper entitled, The Extension of the Law of Gravitation to Stellar Systems, and the theoretical difficulties arising therefrom in the case of stars like Groombridge 1830, and also in the table of star distances given in light-years, so called.

But the most important feature of the atlas is, of course, its star maps. These are nearly the same in size as those of Heis. Klein's maps are about 12½ inches by 9¼ inches while those of Heis are about 13 inches by 8½, the former being a trifle the larger. Heis' circum-polar map places the North Pole 10° from the center of the map and 0° of right ascension at the upper left hand corner, and shows 40° of polar distance in the direction of 18*h* right ascension, and 20° in the direction of 6*h*. Klein puts the pole in the center of his map and gives 35° of north polar distance on every hour circle, has 0*h* of right ascension at the bottom of the map, and draws parallels to the equator at every 5° of declination. In the eleven maps that follow, Heis projects both meridians and parallels as arcs of circles and shows the celestial sphere to 30° south declination. Klein proceeds differently. From the second to the fifth map inclusive, he draws the meridians as straight lines, and the parallels as arcs or circles, showing 5*h* of right ascension from center to center, except in the fifth map, which

should give only $4h$. The last six maps present the equatorial regions of the sphere to $-32°$ and $+26°$ in declination. The middle of the first map is $2h$ in right ascension, the second $6h$, the third $10h$, etc. The projections of hour circles and parallels in these maps are both in straight lines, which is often spoken of as the cylindrical method. Though it would be interesting to consider the relative merits of the different methods of making maps chosen by these two authors, yet it is not necessary here, since the scale of each is small, and their differences of error a quantity of still lower order.

In Heis' maps the Milky Way is beautifully figured; in Klein it is omitted altogether. Heis gives the old constellation figures, the outlines, star designations, the names of the constellations in red; Klein uses the same color, omits the pictures of animals and things, gives the outlines of the constellations, designates many more objects with catalogue numbers, so that the map, at first sight looks a little crowded; but every feature is clean and distinct, and we have not yet noticed an object or point in any way ambiguous.

Following the star maps are several double page lithograph plates representing favorite celestial objects. The first is the star cluster of the Pleiades reproduced from a photograph by the Brothers Henry of Paris. Then follow Bond's Great Nebula in Orion, Trouvelot's representation of Nebula G. C. 4355, Vogel's star clusters G. C. 4440 and 1361; Trouvelot's star cluster G. C. 4294; heliographical reproduction of part of the constellation Cygnus from a photograph by Brothers Henry, Paris; Holden's Ring Nebula in Lyra, G.C. 4447, and seventeen other fine illustrations by the same and other equally competent artists.

The publishers have done their part very neatly and well, and wonder is that the book can be sold for the low price of $2.50 per copy.

Books Received.

A Treatise on Trigonometry by Professors Oliver, Wait and Jones, of Cornell University. Third Edition. Ithaca, N. Y., Dudley F. Finch, Publisher, 1889.

Logarithmic Tables, by Professor George Williams Jones, of Cornell University. Publisher, Dudley F. Finch, 1889.

STAR ATLAS.

Containing Maps of all the Stars from 1 to 6.5 magnitude, between the North Pole and 34° South Declination, and of all Nebulæ and Star Clusters in the same region which are visible in telescopes of moderate powers. With explanatory text by

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"I have carefully examined the Star Atlas . . . and consider it in every respect a first class work. . . . The maps are clear, distinct and remarkably accurate; the boundaries of the constellations agree exactly with the very best authorities; the names are marked distinctly, without any pictures of animals (which is a great improvement on most astronomical maps). The nebulæ and star clusters are all marked and accurately named down to such a magnitude as could be seen with an ordinary two or three-inch telescope, and their positions are remarkably accurate. The descriptions of astronomical phenomena agree with the best authorities and with the heavens; they are accurate and just as exhaustive as possible for the space. The pictures of some of the most important phenomena are derived from the best sources, some of them excellent copies, the others quite accurate representations of the heavens. The whole work was written by an astronomer of acknowledged reputation, which in itself is a sufficient recommendation. The book is very handy, and it surprises me how much is contained in such a small compass; it is practical, for no stars or other objects are put down below a certain limit, and it is practically exhaustive up to that limit. There are three classes of people that it may benefit. 1st. Astronomers who are particularly engaged in comet hunting, on account of the nebulæ being marked as they are. 2d. Amateurs with a two or three-inch telescope, who want to get a general view of the sidereal heavens. 3d. Students, for I think a copy of this atlas would be extremely useful as a handbook wherever sidereal astronomy is taught in any manner. It gives me great pleasure to state that I do not know of any book of its kind that contains so much accurate knowledge in so small a compass."—EDGAR FRISBY, Professor of Mathematics, U. S. Navy. U. S. Naval Observatory, Washington, D. C.

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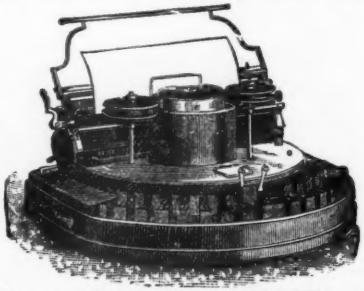

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